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Risk factors for scald injury in children under 5 years of age: A case–control study using routinely collected data☆

M. Shah [a], E. Orton [a,*], L.J. Tata [b], C. Gomes [a], D. Kendrick [a]

[a] Division of Primary Care, University Park, University of Nottingham, Nottingham, United Kingdom
[b] Division of Epidemiology and Public Health, Nottingham City Hospital, University of Nottingham, Nottingham, United Kingdom

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ABSTRACT

Scald injury is common, accounting for half of all burns in pre-school children. Most scalds are preventable and health professionals can play an important role in targeting interventions to those at greatest risk. However, the potential for routinely collected medical data to be used to identify high risk children has not been well explored.

We used a matched case–control study to identify risk factors for first scald injury in children under 5 using a large, nationally representative database of routinely collected primary care records. Among 986 cases and 9240 controls, male gender, age (2 years), higher birth order, single-parent families and increasing index of material deprivation were associated with increased odds of scald injury. Older maternal age at childbirth was associated with decreased odds of scald injury.

Children at risk of scald injury can be identified from routinely collected primary care data and primary care practitioners can use this information to target evidence-based safety interventions.

1. Introduction

Scald injuries are an important public health issue since most are preventable, yet cause considerable morbidity and mortality. They can be associated with significant pain and prolonged treatment with some physical and psychological effects lasting a lifetime [1]. Scalds account for one-third to one-half of all burns in high and middle income countries [2,3] and globally account for approximately 5% of all burn-related deaths [1], with pre-school children experiencing a disproportionately high mortality rate compared to other age groups [2,4,5].

Scalds also have significant economic implications. For example, in the United States the total annual cost of scald-related injuries and deaths among children younger than 14 years of age has been estimated to be $2.1 billion, with children under age 4 accounting for $1.2 billion of this [6]. In the United Kingdom the British Burn Association calculated that a very serious bath water scald undergoing intensive care treatment would cost £172,821 [7], equivalent to approximately USD $280,000 or €215,000.

Prevention strategies vary across the world too. The American Academy of Paediatrics recommend that injury prevention counselling is integrated into every well-child visit and stress that paediatricians can be effective advocates for injury prevention through work with a range of community partners such as schools and child care centres [8]. In England the National Institute of Health and Clinical Excellence

* *Corresponding author at*: Floor 13, Tower Building, University Park, Nottingham NG7 2RD, United Kingdom. Tel.: +44 1158468312/7812792549; fax: +44 1158466904.
E-mail address: elizabeth.orton@nottingham.ac.uk (E. Orton).

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(NICE) guidelines [9,10] recommend that primary care doctors play a role in injury prevention. They suggest that doctors offer education and advice to families whose children are at the greatest risk of injury and refer them for home safety assessments and environmental alterations such as the installation of thermostatic mixing valves. Interventions such as this are both cost-effective [11] and acceptable to families [12].

The identification of children at the greatest risk of scald injury is important if effective interventions are to be targeted to those in most need. Whilst there is a body of evidence relating to risk factors for more severe scalds in pre-school children, where hospital admission is required or where medical attention was sought from accident and emergency departments [13–16], there is a paucity of information relating to risk factors for the range of scald injuries in the general population. We therefore conducted a population-based case–control study in children under 5 years of age, to address this research gap and to ascertain whether routinely available health data can be used to identify to at-risk households.

2. Methods

2.1. Participants and setting

We used prospectively collected longitudinal data from The Health Improvement Network (THIN). THIN is a computerised database of routinely collected patient records that are representative of general practices across the UK [17] and has been shown to be a valid data source for epidemiological studies [18]. In the UK primary, secondary and tertiary healthcare services are provided free at the point of delivery (through the National Health Service) but access is generally co-ordinated in primary care by the patient's General Practitioner (GP), particularly for secondary care services. Because of this, GPs are notified of planned or emergency healthcare utilisation outside of primary care (e.g. hospital admissions, emergency department or out-patient attendances) and together with the primary care consultations hold information on medical diagnoses, general health information and prescriptions. This information is recorded in the electronic medical record of each patient and entries are made either by the GP or by an allied professional in the general practice using Read codes which are based on the International Classification of Diseases version 10 (ICD-10) [19]. All patient records are provided to researchers only in anonymised fashion and at the time of data extraction for this study THIN comprised 255 practices with longitudinal records of 3.9 million patients.

Study participants were from an open cohort of children born between January 1988 and November 2004 who were registered with a THIN general practice. Their records were linked to their mothers' general practice records [20]. Briefly, each child was linked to its mother via an algorithm that identified a woman aged 15–50 years registered in the same household as the child with birth-related Read codes in her general practice record at the time of the child's date of birth. Cases and controls were a subset of children from a previous case–control study exploring risk factors for childhood fractures, poisonings and thermal injuries [21].

2.2. Study design

We used scald-related Read codes recorded in children's primary care records up to the age of 5 years, regardless of whether the injury may have initially presented or been treated in primary or secondary care and regardless of injury intent. The Read codes used covered the ICD-10 categories X10–X13, X18, X77, X98 and Y27. Each case was matched on their general practice with up to 10 controls that did not have a Read code for scald injury and were under 5 years of age at the date of their matched case's scald.

2.3. Risk factor variables

We assessed child, maternal and household risk factors for scalds [13–16] that were available in THIN. Child covariates included gender, age at the time of injury and birth order. Maternal covariates included age at childbirth, depression during pregnancy or 6 months after delivery (referred to as perinatal depression) and hazardous/harmful alcohol consumption (as defined by alcohol-related morbidity medical codes) prior to the scald injury. Household covariates included the Townsend Index of material deprivation [22] (obtained from the home postcode) and the number of adults within the household (older than 16 years).

2.4. Statistical methods

All analyses were conducted using the statistical package Stata version SE11. Conditional logistic regression was used to estimate univariable and multivariable odds ratios (OR) and 95% confidence intervals (CI). Models were built using the procedure described by Collett [23], with all covariates described above included in the initial model and child age and gender retained as a priori confounders as these are known to be associated with injury. Potential interactions were identified a priori based on theoretical plausibility (e.g. between maternal smoking and household deprivation) and co-linearity was checked using the covariate correlation matrix estimates and by calculating the variance inflation factor.

3. Results

From an open cohort of 180,064 linked mother–child pairs, 986 cases of scald injury and 9240 matched controls were identified. The characteristics of the cases and controls, unadjusted odds ratios and factors that were found to be significant risk factors in the fully adjusted model are shown in Table 1.

Multivariable analysis showed that boys were 34% more likely to have a scald injury (OR 1.34, 95% CI 1.17–1.54). The odds of scald injury showed an *n*-shaped relationship with child age, with the greatest risk at 1–2 years (OR 2.40, 95% CI 2.05–2.81) when compared with those under 1 year of age. Higher birth order (where the higher the number is the more older siblings the child has) was also associated with higher odds of scald injury (OR 2.17, 95%CI 1.60–2.94 for children born 3rd or later compared to those born first, test for trend $p < 0.001$) whilst older maternal age at childbirth was associated with a decreasing odds of scald injury, with children born to mothers

Table 1 – Characteristics of cases and controls and odds ratios for scald injury according to socio-demographic risk factors.

	Frequency (%)		Unadjusted odds ratios (95% confidence intervals)	Adjusted odds ratios (95% confidence intervals)[a]
	Case (N = 986)	Control (N = 9240)		
Gender				
Girl	412 (41.78)	4511 (48.82)	1.00	1.00
Boy	574 (58.22)	4729 (51.18)	1.32 (1.16–1.51)	1.34 (1.17–1.54)
Age of child at injury				
0–12 months	327 (33.16)	3321 (35.94)	1.00	1.00
13–24 months	461 (46.75)	2038 (22.06)	2.33 (2.00–2.72)	2.40 (2.05–2.81)
25–36 months	121 (12.27)	1493 (16.16)	0.82 (0.66–1.02)	0.86 (0.68–1.07)
37+ months	77 (7.81)	2388 (25.84)	0.31 (0.24–0.41)	0.33 (0.26–0.43)
Birth order				
1st child	644 (65.31)	6740 (72.94)	1.00	1.00
2nd child	278 (28.19)	2174 (23.53)	1.43 (1.22–1.67)	1.44 (1.22–1.69)
3rd or later	64 (6.49)	326 (3.53)	2.30 (1.72–3.07)	2.17 (1.60–2.94)
Age of mother at birth of child (years)				
Under 20	86 (8.72)	496 (5.37)	1.00	1.00
20–29	496 (50.30)	4717 (51.05)	0.60 (0.47–0.78)	0.64 (0.49–0.84)
30–39	394 (39.96)	3819 (41.33)	0.60 (0.46–0.78)	0.70 (0.53–0.92)
40 and over	10 (1.01)	208 (2.25)	0.28 (0.14–0.56)	0.32 (0.16–0.64)
Perinatal depression				
No	899 (91.18)	8614 (93.23)	1.00	–
Yes	87 (8.82)	626 (6.77)	1.34 (1.06–1.70)	
Maternal smoking status				
Non-smoker	471 (47.77)	4470 (48.38)	1.00	
Current or ex-smoker	311 (31.54)	2515 (27.22)	1.18 (1.08–1.38)	–
Not known	204 (20.69)	2255 (24.40)	0.75 (0.62–0.92)	
Record of hazardous or harmful maternal alcohol consumption before the scald injury				
No	978 (99.19)	9199 (99.56)	1.00	–
Yes	8 (0.81)	41 (0.44)	1.82 (0.85–3.93)	
Household composition				
Two adults	446 (45.23)	4776 (51.69)	1.00	1.00
Single adult	450 (45.64)	3661 (39.62)	1.31 (1.13–1.51)	1.26 (1.08–1.46)
Other family structure	90 (9.13)	803 (8.69)	1.22 (0.95–1.56)	1.15 (0.89–1.49)
Deprivation (quintile of townsend score)				
(1) Least deprived	173 (17.55)	1982 (21.45)	1.00	1.00
(2)	151 (15.31)	1725 (18.67)	1.04 (0.82–1.31)	1.05 (0.83–1.34)
(3)	167 (16.94)	1734 (18.77)	1.19 (0.94–1.51)	1.17 (0.92–1.50)
(4)	210 (21.30)	1656 (17.92)	1.63 (1.30–2.06)	1.55 (1.21–1.97)
(5) Most deprived	204 (20.69)	1375 (14.88)	1.98 (1.55–2.54)	1.82 (1.40–2.37)
Not known	81 (8.22)	768 (8.31)	1.19 (0.77–1.86)	1.10 (0.70–1.73)

[a] Model mutually adjusted for all variables where odds ratios are given.

of 40 years and over having the lowest odds of scald injury when compared with children of teenage mothers (OR 0.32, 95% CI 0.16–0.64, test for trend $p = 0.077$). Children living in single adult households had increased odds of scald injury compared to two adult households (OR 1.26, 95% CI 1.08–1.46) and increasing index of material deprivation was associated with an increasing odds of scald injury (OR 1.82, 95% CI 1.40–2.37 for the most deprived compared to the least, test for trend $p < 0.001$). No statistically significant interactions or co-linearity were found between covariates.

4. Discussion

This study describes risk factors for scald injury in children under 5 years of age using routinely collected primary care data in the UK. Data included information from primary and secondary healthcare services and we did not distinguish between intentional and unintentional scalds. This was because 'intent' is unlikely to be well recorded or accurately ascertained in primary or secondary care [24–26]. We identified a range of risk factors that increase the odds of a child experiencing any scald that undergoes medical attention. These were having a young mother, living in a single-parent household, living in a more deprived household, being male, age 1–2 years and being a child with older siblings. We did not find an association between scald injury and perinatal depression (depression diagnosed during or within 6 months of birth), smoking status or alcohol misuse by the mother. It is possible that we did not find an association between perinatal depression and scald injury because scalds are more common in children aged 1–2 years at which point depression for some mothers will have resolved. We cannot rule out that an association exists with depression diagnosed at other time periods however.

We used a large primary care database (THIN) for this study which has been demonstrated to be broadly representative of all general practices in the UK [17], meaning that our findings

are likely to be applicable to the wider general population and to other higher income countries with well-developed primary health care systems. Furthermore, data are entered contemporaneously, minimising the effect of recall bias which often occurs in case–control studies where exposure information is collected retrospectively. Unlike previous studies our study cases capture injuries presenting to primary or secondary care services, again making the findings applicable to a broader range of medically attended scalds [13–16,21].

We identified child gender and age as risk factors for scald injury, which is consistent with the existing literature [2,27–30]. Flavin et al. and Agran et al. highlight that as children develop, the types of injuries that they are susceptible to change also. Both studies show that by one year of age children have an increased risk of burn injury, likely due in part to the development of reaching and curiosity behaviours [29,30].

The protective effect of two-parent households is consistent with findings from previous work [31] and may be explained by supervisory practices or psychosocial risks [31,32]. Likewise, our finding that being more deprived, having a younger mother and also older siblings increase the risk of scalds is consistent with previous work [13,27,28,31,33].

Of course some information on potential risk factors is not available in routine primary care data. For example it is not possible to ascertain how well-safety practices are observed, such as cooking with pans on the rear cooker rings out of reach of children, or ensuring that baths are always supervised whilst being filled. However, our study has demonstrated that sufficient information is present in the primary healthcare record to allow healthcare professionals identify those households at greatest risk of scald injury and to better target effective interventions.

4.1. *Key messages*

This study demonstrates that population-based routine primary care data can be used to identify children under 5 years of age at higher risk of scalds. Primary healthcare professionals could use this information locally to target evidence-based interventions during clinical consultations. Interventions could include home safety advice and recommending that homes are fitted with safety equipment such as thermostatic mixing valves where these are available.

Sources of funding

The study was unfunded.

Conflict of interest

The authors have no conflicts of interests to declare.

Ethics statement

We used The Health Improvement Network (THIN) primary care data for this research. The company that own THIN (Cegedim Strategic Data Medical Research) has received ethical approval for studies using only pre-collected, anonymised data to undergo only a scientific review. This applies to our study and we have complied fully with this procedure. A research protocol was submitted to the Scientific Review Committee and the protocol was approved in October 2009. Patient informed consent is not required under this agreement nor is additional ethics approvals from either the National Health Service ethics committees or from The University of Nottingham.

REFERENCES

[1] Peden M, Oyegbite K, Ozanne-Smith J, Hyder A, Branche C, et al. World report on child injury prevention. Unicef: World health Organisation; 2008.
[2] Delgado J, Ramirez-Cardich ME, Gilman RH, Lavarello R, Dahodwala N, et al. Risk factors for burns in children: crowding, poverty, and poor maternal education. Inj Prev 2002;8:38–41.
[3] Forjuoh SN. Burns in low- and middle-income countries: a review of available literature on descriptive epidemiology, risk factors, treatment, and prevention. Burns 2006;32:529–37.
[4] Morrow SE, Smith DL, Cairns BA, Howell PD, Nakayama DK, et al. Etiology and outcome of pediatric burns. J Pediatr Surg 1996;31:329–33.
[5] World Health Organization. The global burden of disease: 2004 update. Switzerland: World Health Organization; 2008.
[6] Miller TR, Romano EO, Spicer RS. The cost of childhood unintentional injuries and the value of prevention. Fut Child 2000;10:137–63.
[7] Gillam S, Abbott S, Banks-Smith J. Can primary care groups and trusts improve health? Br Med J 2001;323:89–92.
[8] Gardner HG. Office-based counseling for unintentional injury prevention. Pediatrics 2007;119:202–6.
[9] National Institute for Health and Clinical Excellence. Preventing unintentional injuries among under-15s in the home (PH30). London: National Institute for Health and Clinical Excellence; 2010.
[10] National Institute for Health and Clinical Excellence. Strategies to prevent unintentional injuries among under-15s (PH29). London: National Institute for Health and Clinical Excellence; 2010.
[11] Phillips CJ, Humphreys I, Kendrick D, Stewart J, Hayes M, et al. Preventing bath water scalds: a cost-effectiveness analysis of introducing bath thermostatic mixer valves in social housing. Inj Prev 2011;17:238–43.
[12] Kendrick D, Stewart J, Smith S, Coupland C, Hopkins N, et al. Randomised controlled trial of thermostatic mixer valves in reducing bath hot tap water temperature in families with young children in social housing. Arch Dis Child 2011;96:232–9.
[13] Reading R, Langford IH, Haynes R, Lovett A. Accidents to preschool children: comparing family and neighbourhood risk factors. Soc Sci Med 1999;48:321–30.
[14] Bijur PE, Kurzon M, Overpeck MD, Scheidt PC. Parental alcohol use, problem drinking, and children's injuries. J Am Med Assoc 1992;267:3166–71.
[15] MacInnes K, Stone DH. Stages of development and injury: an epidemiological survey of young children presenting to an emergency department. BMC Public Health 2008;8:120.
[16] Hippisley-Cox J, Groom L, Kendrick D, Coupland C, Webber E, et al. Cross sectional survey of socioeconomic variations in severity and mechanism of childhood injuries in Trent 1992–7. Br Med J 2002;324:1132–4.

[17] Bourke A, Dattani H, Robinson M. Feasibility study and methodology to create a quality-evaluated database of primary care data. Inform Prim Care 2004;12:171–7.
[18] Coles CD, Strickland DC, Padgett L, Bellmoff L. Games that "work": using computer games to teach alcohol-affected children about fire and street safety. Research in Developmental Disabilities 2007;28(5):518–30.
[19] Cross D, Stevenson M, Hall M, Burns S, Laughlin D, et al. Child pedestrian injury prevention project: student results. Preventive Medicine 2000;30(3):179–87.
[20] Tata LJ, Lewis SA, McKeever TM, Smith CJ, Doyle P, et al. Effect of maternal asthma, exacerbations and asthma medication use on congenital malformations in offspring: a UK population-based study. Thorax 2008;63:981–7.
[21] Orton E, Kendrick D, West J, Tata LJ. Independent risk factors for injury in pre-school children: three population-based nested case–control studies using routine primary care data. PLoS ONE 2012;7:e35193.
[22] Townsend P, Phillimore P, Beattie A. Health and deprivation: inequality and the North. London: Croom Helm; 1988.
[23] Collett D. Modelling survival data in medical research. Florida, USA: Chapman & Hall/CRC; 2003.
[24] Emery CA, Cassidy JD, Klassen TP, Rosychuk RJ, Rowe BH. Effectiveness of a home-based balance-training program in reducing sports-related injuries among healthy adolescents: a cluster randomized controlled trial. CMAJ 2005;172(6):749–54.
[25] Karlinsky H, Dunn C, Clifford B, Atkins J, Pachev G, et al. Workplace injury management: using new technology to deliver and evaluate physician continuing medical education. Journal of Occupational Rehabilitation 2006;16:719–30.
[26] Maio RF, Shope JT, Blow FC, Gregor MA, Zakrajsek JS, et al. A randomized controlled trial of an emergency department-based interactive computer program to prevent alcohol misuse among injured adolescents. Ann Emerg Med 2005;45(4):420–9.
[27] Peck MD. Epidemiology of burns throughout the world. Part I: Distribution and risk factors. Burns, 2011 37:1087–100.
[28] den Hertog PC, Blankendaal FA, ten Hag SM. Burn injuries in The Netherlands. Accid Anal Prev 2000;32:355–64.
[29] Flavin MP, Dostaler SM, Simpson K, Brison RJ, Pickett W. Stages of development and injury patterns in the early years: a population-based analysis. BMC Public Health 2006;6:187.
[30] Agran PF, Anderson C, Winn D, Trent RB, Walton-Haynes L, et al. Rates of pediatric injuries by 3-month intervals for children 0 to 3 years of age. Pediatrics 2003;111: e683–92.
[31] O'Connor TG, Davies L, Dunn J, Golding J. Distribution of accidents, injuries, and illnesses by family type, ALSPAC Study Team. Avon Longitudinal Study of Pregnancy and Childhood. Pediatrics 2000;106:E68.
[32] Klein D. Societal influences on childhood accidents. Accid Anal Prev 1980;12:275–81.
[33] Hjern A. Socio-demographic risk factors for home-type injuries in Swedish infants and toddlers. Acta Paediatr 2001;90:61–8.